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HARVIE HEIGHTS
FEASIBILITY STUDY OF
SEWAGE COLLECTION
AND TREATMENT

SCOTT & ASSOC.

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HARVIE HEIGHTS

FEASIBILITY STUDY OF

SEWAGE COLLECTION

AND TREATMENT

SCOTT & ASSOC. ENGINEERING LTD.

January 4, 1985

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ENGINEERING LTD.

January 4, 1985

Alberta Municipal Affairs
Improvement District #8
P.O. Box 665
Canmore, Alberta
T0L 0M0

Attention: Mr. Bertram Dyck
Manager

Dear Sir:

Re: Harvie Heights Feasibility Study - Sewage Collection and Treatment

We take pleasure in submitting our final report regarding sewage collection and treatment options to serve the Hamlet of Harvie Heights.

We are pleased to have had the opportunity to undertake this study and we trust the information provided herein will assist the I.D. 8 Council and yourself in the decision making process regarding wastewater facilities for Harvie Heights.

Should additional information or clarification be required, we would be pleased to meet with Council and/or yourself at your convenience.

Yours very truly,

Bryan G. Scott, P.Eng.

BGS/js

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EXECUTIVE SUMMARY

1) Introduction

The objective of this study is to review potential methods of wastewater collection and treatment, review capital and operating costs, consider potential applicable grants, and resultant financial analyses.

2) Population Projections

A design life for twenty to twenty-five years has been considered, and a design population level of 500 persons.

3) Wastewater Collection

- Various alternatives are available to Harvie Heights ranging in capital costs from $735,000 to $916,000; highly dependent on the methodology utilized for wastewater collection.

- Serious consideration should be given by I.D. 8 Council and the residents of Harvie Heights to a system utilizing both a gravity and a low pressure sewer system, and lane serviced in particular blocks. Total capital cost estimated at $735,000.

- The amortized costs of a collection system costing $735,000 results in the following anticipated yearly costs (estimated potential range available to I.D. 8 Council):

* Option	Residential		Commercial	
I	$7.81 FF	$585.75/yr.	$7.81 FF	$1562.00/yr.
II	(acreage)	$424.89/yr.	(acreage)	$3739.06/yr.

* Note: Based on a Residential Lot 75 FF and .25 acres in size and Commercial Lot 220 FF and 2.2 acres in size.

4) Wastewater Treatment

- Wastewater treatment system deemed most favorable to I.D. 8, considering both capital and operation costs, is the aerated lagoon system.

- The amortized yearly costs and operating costs of such a system could result in the following range of options available to I.D. 8 Council for consideration:

* Option	Residential	Commercial
A	$224.57	$ 598.00
B	$128.59	$1533.67
C	$ 54.33	$1982.23

* Note: Based on a Residential Lot 75 FF and .25 acres in size and Commercial Lot 220 FF and 2.2 acres in size.

HARVIE HEIGHTS FEASIBILITY STUDY

OF SEWAGE COLLECTION AND TREATMENT

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I. INTRODUCTION

A. GENERAL

The Hamlet of Harvie Heights is situated approximately two kilometers west of Canmore, on the TransCanada Highway. Just to the northwest of Harvie Heights is the entrance to Banff National Park.

B. TERMS OF REFERENCE

Scott & Assoc. Engineering Ltd. were retained by Improvement District 8 Council (Alberta Municipal Affairs) to undertake a wastewater collection and treatment study on behalf of the Hamlet of Harvie Heights. The terms of reference for this investigation are outlined as follows:

1. Land Use Analyses
   - review of current population levels and projected growth rates
   - projected future land usages
2. Sewage Collection and Treatment
   a) Review of sewage collection alternatives (conventional gravity, low pressure and vacuum systems)
   b) Sewage treatment system alternatives
      - conventional lagoon
      - aerated lagoon
      - mechanical system
      - discharge to Canmore system
   c) Geotechnical and hydrological investigations
   d) Review of findings in the Bow Corridor Utilities Study
   e) Review compatibility of prescribed findings with Alberta Environment standards
   f) Financial Analyses
      i) capital costs
      ii) operation and maintenance
      iii) grants
      iv) frontage assessments

II. BASIC DATA AND DESIGN CRITERIA

A. POPULATION PROJECTIONS

The 1981 Federal census indicated that Harvie Heights had a population of 159 persons (permanent residents). However, Harvie Heights has approximately 120 residential lots, and a highway commercial base of approximately 29 acres.

The "Bow Corridor Regional Study" prepared for Alberta Environment in July of 1983 indicated at that time the second home residents were an additional 228 persons, based on the 1981 assessment roll. Therefore, the residential area is assumed to have a present population level of approximately 390 persons.

Discussions with CRPC and I.D. 8 officials indicate that future growth of other areas east and south of Harvie Heights is not anticipated within the next 10 years as a minimum.

Based on the aforementioned analyses, for a design life of twenty to twenty-five years, a population level of 500 persons has been utilized for this study.

III. SEWAGE COLLECTION SYSTEM

A. GENERAL

The purpose of this section is to provide alternative means of wastewater collection for the Harvie Heights area.

This study looks in detail at three major options only. Of these three options, two other potential combinations are considered, however it should be stressed that there are various numbers of combinations available.

B. WASTEWATER COLLECTION SYSTEMS - METHODOLOGY

1. Conventional Gravity Sewer

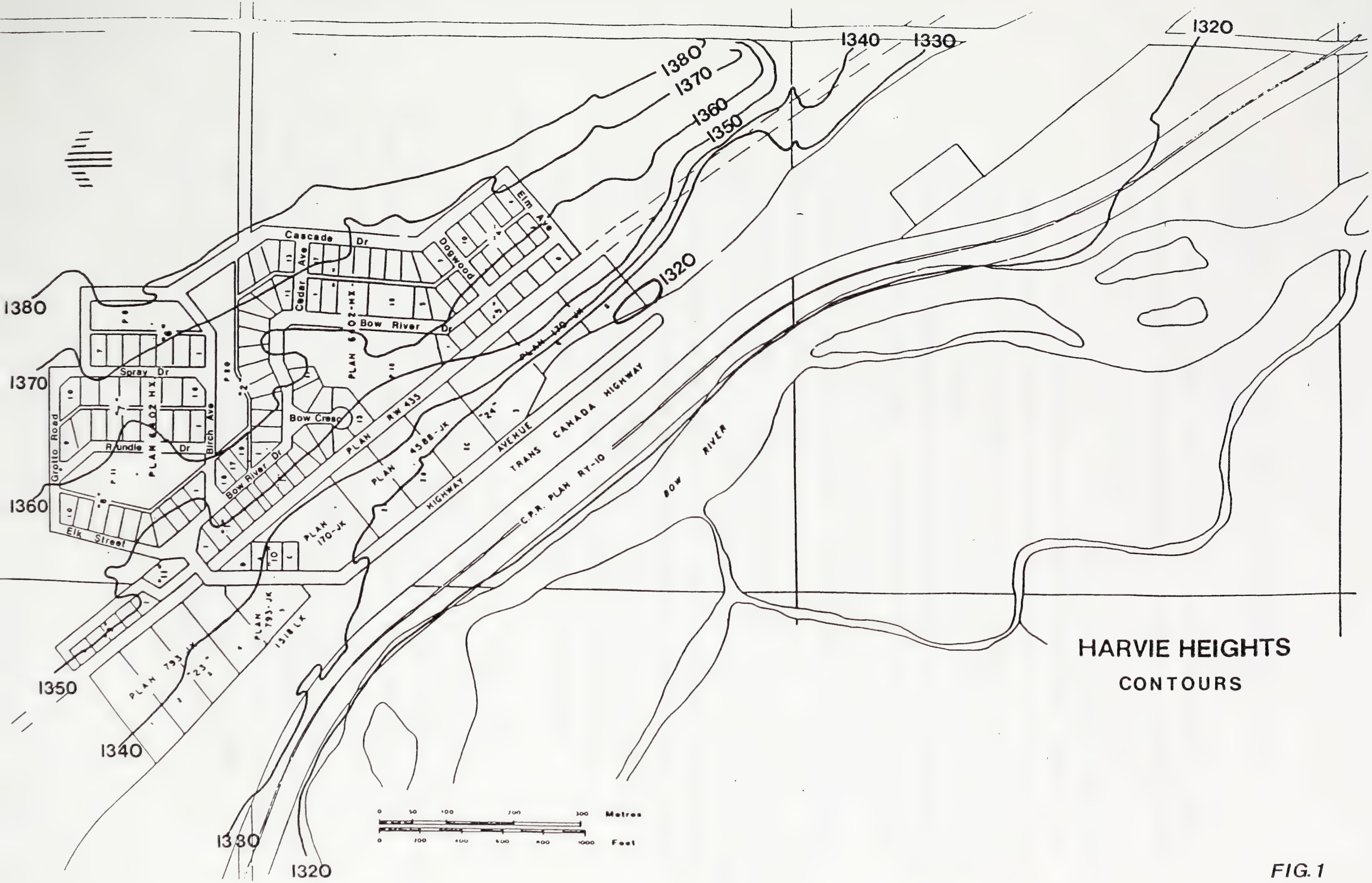
Most people identify with the conventional gravity sewer system, as it is commonly utilized in most urban settings. A minimum diameter main of 200mm (8 inch) laid on a slight grade, is utilized to carry the wastewater.

2. Low Pressure Sanitary Sewers (LPSS)

A concept utilized readily in European countries, and now in Canada, where there is undulating terrain and/or high groundwater tables, is the LPSS. (Note Figure 1 for topographic features.)

Each home has a small tank unit (100+ litres (25 gal.) complete with a small grinder pump, which operates automatically on set liquid levels within the tank. Small diameter mains from the house and in the street carry sewage with or against the grade (to a maximum elevation of 80 ft. against the grade). The advantages of this system are as follows:

- water-tight system (reduced groundwater infiltration)
- minimizes deep cuts in mountainous terrain as opposed to the conventional gravity sewer
- reduces (or even eliminates) the need for major lift stations



HARVIE HEIGHTS
CONTOURS
1320
1330
1340
1350
1360
1370
1380
Cascade Dr
Cedar Ave
Dogwood
Elm Ave
Bow River Dr
Spray Dr
Rundle Dr
Birch Ave
Grotto Road
Elk Street
Bow Cresc
PLAN 6402 HX
PLAN 170-JK
PLAN RW 435
PLAN 4588-JK
PLAN 793-JK
1318 LK
HIGHWAY AVENUE
TRANS CANADA HIGHWAY
C.P.R. PLAN RY-10
BOW RIVER
Metres
Feet

FIG. 1

- minimal power operating and maintenance costs (approx. 2 hp motor)
- the capital cost for a unit is approximately $3500. (There could be an additional plumbing cost of $1000 for tying in to the street main.) In comparison to trying to service a house whose main floor elevation is situated significantly below the road grade, the costs for a conventional service lead to the gravity sewer could cost between $2000 to $3000 excluding the possible high capital costs of the collection system plus the damage to the resident's yard. Conversely, a shallow LPSS service main can be installed at a shallow depth and would be insulated to prevent freezing, and would result in minimal yard damage.

3. Vacuum Sanitary Collection System

Another system utilized extensively in Europe in mountainous terrain is the vacu-san system. As the name implies, this system operates under a vacuum condition. This system requires major modifications to the house plumbing fixtures and because the costs are thought to be unrealistic for this particular application, no further consideration is given in this study.

C. SERVICING OPTIONS

The preliminary review that we have undertaken suggests that there are numerous combinations available to service the Harvie Heights area, in particular the residential area. (The highway commercial properties are readily serviced with a gravity main in the front of each lot. Due to the unpaved westerly portion of land remaining in the road right-of-way, the sanitary main could be laid in this zone, while disturbing a minimal amount of paved road sections.)

The study will discuss in general three options, and two possible combinations for the Hamlet's consideration.

1. Option I(A) (Figure 2 and Table I)

As most communities seem to want a conventional sewer system in the road right-of-ways, an analysis of this methodology was undertaken.

Unfortunately, the undulating terrain, as evidenced by the contours shown on Figure 1, requires many sections of sewer to be laid at a significant depth (up to 7m as opposed to the normal 2.4 meter depth).

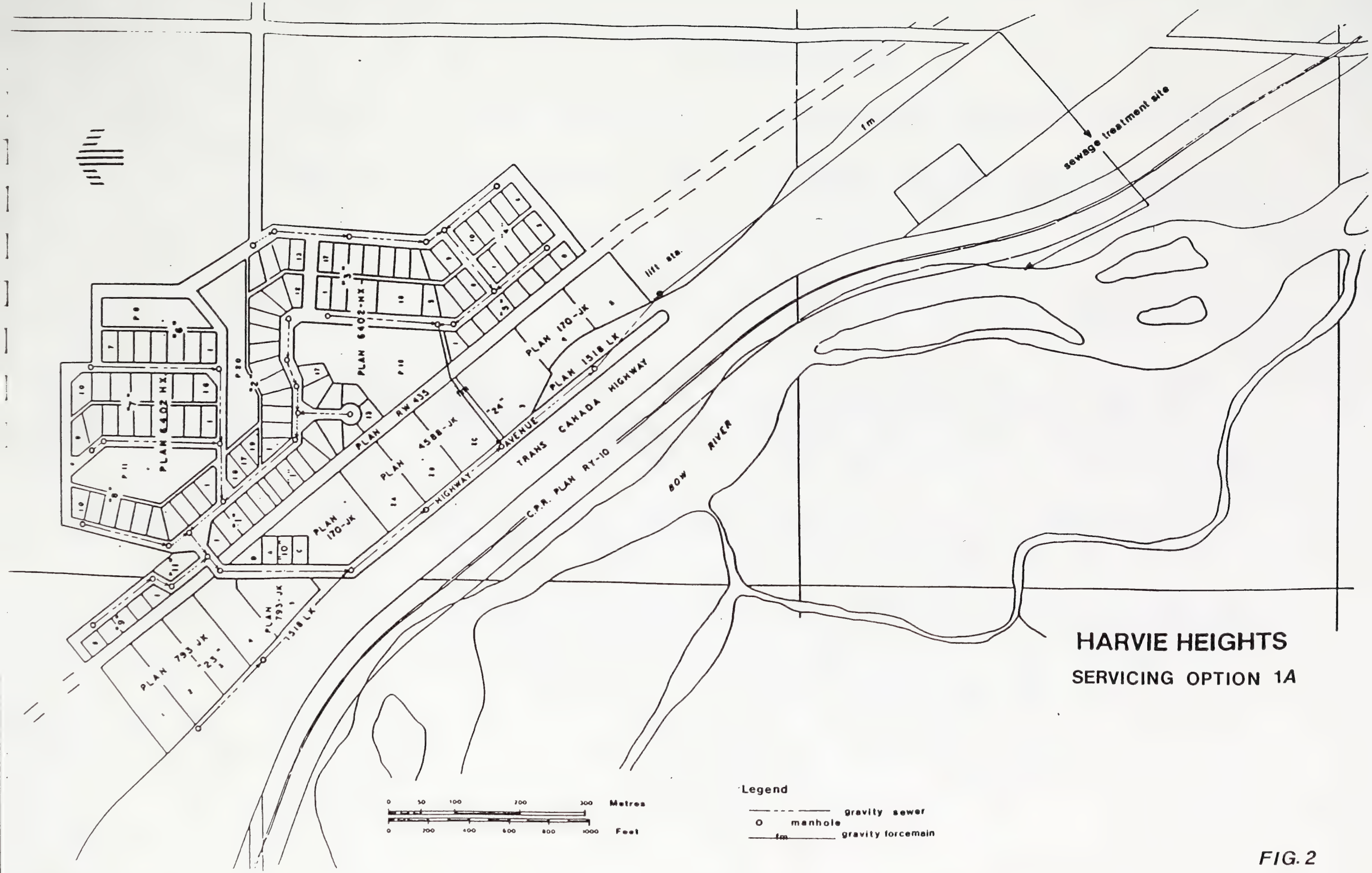
The anticipated costs for this overall servicing technique are envisaged at approximately $916,000. Besides servicing concerns with terrain, the costs are somewhat high because of two other factors. These factors are for the costs of repaving the residential streets to a 50mm (2 inch) thickness which is estimated at approximately $250,000 to $275,000. Also, an allowance has been made (+5%) for a cost which we feel the contractor will add in due to difficulties encountered while trying to service an established residential area. As a minimum, some possible areas which could increase the costs are thought to be as follows:

- special access roads into areas while construction is taking place
- trying to save large trees in front of many of the residences
- restricted hours of operation
- possible damages to existing driveways, fences, etc.

Please note that the repavement of excavated areas and the +5% factor have also been included in all the following options, to provide for equal analyses.

2. Option I(B) (Table I)

In a further attempt to reduce the costs of the conventional gravity system, consideration was given to lane servicing for areas which would require deep cuts for sanitary installation. Possible lane servicing



HARVIE HEIGHTS

SERVICING OPTION 1A

FIG. 2

TABLE I

SANITARY SEWER SERVICING OPTIONS

OPTION	COST	BASIC DESCRIPTION	SPECIAL REQUIREMENTS AND CONDITIONS
I(A)	$916,000	Total gravity, street serviced	Easement through a commercial lot; 30-40 residential lots may require relatively deep house service connections
I(B)	$819,000	Total gravity, street and lane serviced	Easement through a commercial lot; 10-15 residential lots may require relatively deep house service connections
II	$892,000	Total gravity utilizing some of the existing easements and street serviced	Easement agreements required from TransAlta Utilities and reserve; Approximately 20-25 residential lots may require deep service connections; Considerable amount of double servicing
III(A)	$777,000	Combination of gravity and LPSS, all street serviced	Easement through a commercial lot; 40-45 residential lots may require low pressure pump unit
III(B)	$735,000	Combination of gravity and LPSS, some lane serviced	Lane easements are not anticipated due to the possibility of laying shallow lines; 40-45 residential lots may require a low pressure pump unit

of those lots facing on Cascade Drive and Spray Drive could be considered, however, an easement of approximately 3 meters (10 ft.) is suggested to facilitate ease of utility installation and future repair. Servicing costs are envisaged at $819,000.

3. Option II (Figure 3, Table I)

To minimize some of the major cuts, consideration was given to utilizing some of the easements (Trans-Alta Utility right-of-way, for instance) in order to install a gravity system.

Due to considerable double servicing, the costs for this layout ($842,000) seem prohibitive at this time.

4. Option III(A) (Figure 4, Table I)

This option considers a combination of low pressure and gravity main system installed in the streets. The costs for this system are estimated at $777,000.

5. Option III(B) (Table I)

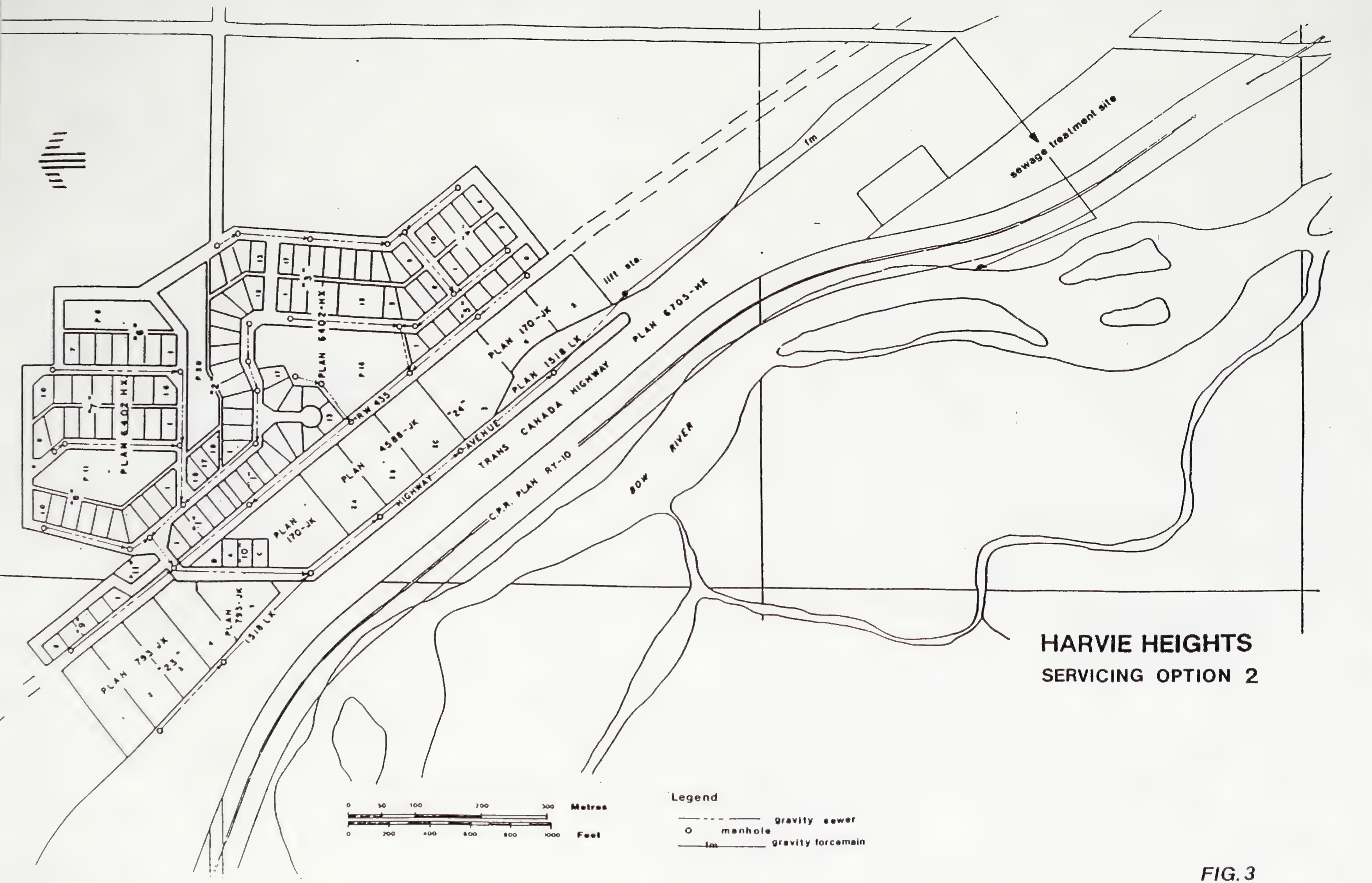
This option expands on III(A) such that costs can be reduced by some lane servicing with LPSS (Cascade Drive and Spray Drive and possible easement servicing of Blk. 9). The capital costs are estimated at $735,000. We believe that a LPSS could be installed in the lanes, possibly without an easement, as the lines could be left shallow and insulated for protection against freezing.

6. Summary

Due to the rolling terrain features, existing paved streets, and some houses whose main floor level are below the existing road-grade, serious consideration must be given to a low pressure sewer system and some lane servicing in order to minimize capital costs.

The detailed design phase will determine exactly which houses and/or lots will require special attention.

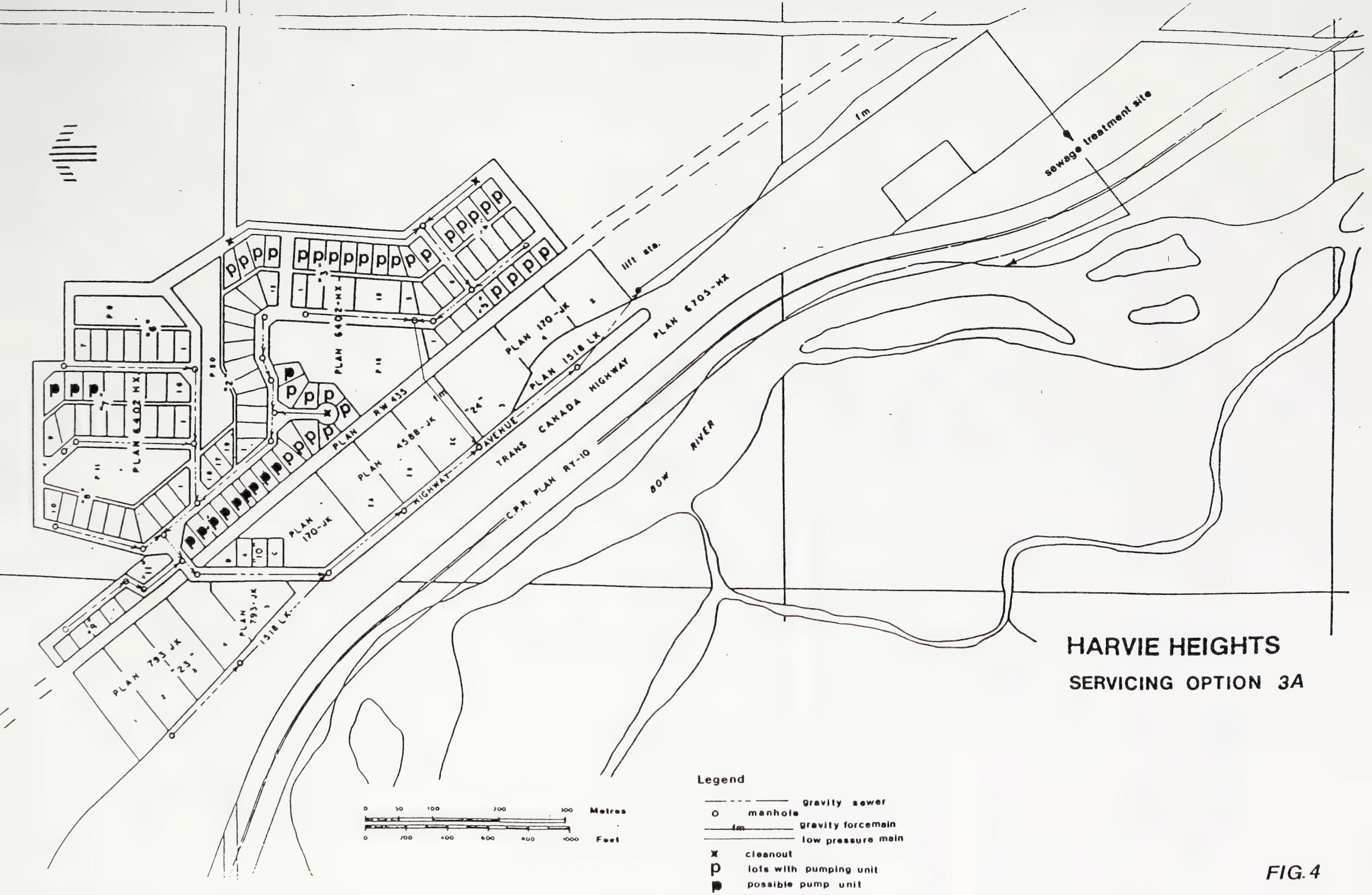
The study only sets forth possible areas of concern at this time.



HARVIE HEIGHTS

SERVICING OPTION 2

FIG. 3



HARVIE HEIGHTS

SERVICING OPTION 3A

FIG. 4

It should be brought to existing homeowners' attention that the following additional estimated costs can be expected for installing sewer service from the property line to the house (or septic tank tie-in), and other associated costs:

1) Low pressure grinder pump $3500 - trenching $200 to $300; in-house plumbing and electrical extra
2) Gravity service lead at normal depth $250 - $350; in-house plumbing extra, if required
3) Gravity service lead at 5m depth average $1500 to $2000; in-house plumbing extra, if required

D. ANNAUL DEBENTURE COST

For our analyses, we have assumed Option III(B), the combination LPSS and Gravity with some lane servicing:

Capital cost $735,000

n = 25 i = 13%

Annual debenture cost = $100,274.83/yr.

Table II provides some alternative methods of annual cost recovery.

TABLE II

VARIOUS ESTIMATED METHODS OF ANNUAL DEBENTURE COST RECOVERY FOR THE SANITARY COLLECTION SYSTEM

ALTERNATIVE	LAND USE DESIGNATION	CONDITION OF ASSESSMENT	COMMENTS	* ESTIMATED (TYPICAL) ANNUAL DEBENTURE SERVICE CHARGE RESIDENTIAL	COMMERCIAL
I	Residential	9,664 FF	Assumes that the frontage of Residential and Commercial is treated equally	$7.81 FF = $585.75	$7.81 FF = $1,562.00
	Highway Commercial	3,181 FF			
		12,845 FF			
II	Residential	120 lots @ .25 acres	Based on assumed acreages	$424.89 per lot	$3,739.06
	Highway Commercial	29 acres of Highway Commercial			

* Assumed Factors
- Annual Debenture Cost = $100,274.83
  n= 25   i= 13%
- Residential Lot = 75 foot frontage and/or 0.25 acres in size
- Commercial Lot = 200 foot frontage and/or 2.2 acres in size

IV. SEWAGE TREATMENT FACILITY

A. GENERAL

The present methodology of sewage disposal in the Harvie Heights area is through the utilization of pumpout tanks and, primarily, sewage tank and field systems.

B. DESIGN PARAMETERS

In accordance with standards established by Alberta Environment, the following basic criteria was utilized for this study:

i) prevailing wind conditions to be considered

ii) lagoons shall be located at least one-half mile (0.8 kilometers) from a town boundary and shall be not less than 300 meters (1000 ft.) from any residences; not less than 30 meters (100 ft.) from a railway, and 90 meters (300 ft.) from a numbered highway (lesser distances may be considered for mechanically operated lagoons).

iii) secondary treatment standards for wastewater effluent

C. DESIGN OPTIONS

1. General

The basic options available for sewage treatment at Harvie Heights are described as follows:

a) conventional lagoons (aerobic or faculative)
b) aerated lagoons (mechanical)
c) mechanical treatment plant
d) treatment at Canmore's existing facility

2. Site Selection Analyses

At this time, the most feasible location of the sewage treatment facility has been determined on a site south of Harvie Heights, as shown on Figures 2, 3 and 4. The basis for this site selection was as follows:

a) prevailing winds
b) proper separation from existing and any future developments in the Harvie Heights area
c) separation distances from the highway and railway are within tolerable limits
d) distance from the present Town of Canmore boundary is deemed acceptable
e) an aerated lagoon or a mechanical plant can be readily installed (no rock or groundwater)
f) the site is not subject to flooding (1:100 yr.)
g) the outfall can be placed on a stretch of the Bow River that is stable to allow for continual effluent discharge

The only concern we see at this time is the actual purchase of the lands, as Alberta Forestry Service has indicated that it is designated as a "... possible special use area, such as a helicopter landing area or other use." (Ray Hill, Alberta Forestry Service - 678-5095, Canmore.)

We believe that a joint use of the lands is still possible with an aerated lagoon or a mechanical plant in conjunction with a helipad situated there. Possible joint sharing of the required access road, power, etc., could be studied.

The following Table III denotes general information on the advantages and disadvantages of the various alternatives of a sewage treatment facility located at Harvie Heights.

3. Conventional Lagoons

Though the conventional lagoon is utilized widely throughout Canada, the land area requirements for such a facility are such that it is not economically feasible to situate a lagoon in the Harvie Heights area due to physical constraints. Also, due to the silt/sand/gravels

TABLE III

POSSIBLE WASTEWATER FACILITIES FOR HARVIE HEIGHTS

ALTERNATIVE	DESCRIPTION	ADVANTAGES	DISADVANTAGES	CAPITAL COST	YEARLY POWER COSTS	YEARLY MANPOWER REQUIREMENTS (Man-Hours)
Conventional Lagoon	Shallow earthen ponds are utilized for natural decomposition by sunlight and oxygen transfer. Normally consist of two anaerobic cells (5 day storage each) and a 7 or 12 month capacity storage pond.	- minimal operating costs - not subject to upset by shock loads (hydraulic or organic) which would probably occur in Harvie Heights - minimal sludge handling (periodic pumpout only)	- large land area required; approximately 12 acres - porosity of silts and gravels in the area necessitates a synthetic liner thereby resulting in a high capital cost - setbacks from residences, roads and rail are more stringent	$450,000 (Note: Based on premise that sufficient land area was available)	$ -0-	110
Aerated Lagoon	Sewage is discharged into two earthen ponds of 30 day detention time each operating in parallel. The ponds are mechanically aerated by means of diffusers located within the lagoons.	- minimal land area required (approx. 1 acre) as compared to a conventional lagoon - continual discharge is available to the Bow River - large organic and hydraulic shock loads would not affect the facility - ease of operation and maintenance as compared to a mechanical plant - periodic sludge handling only - setbacks are less stringent than those for a conventional lagoon	- though land requirements are minimal for an aerated lagoon, a mechanical plant requires less area than the aerated lagoon - requires checking of the mechanical equipment every day	$197,600	$1,200	300
Mechanical Systems - Rotating Biological Contactor	Treatment achieved by slowly rotating discs half submerged in the wastewater, causing a biological growth to occur.	- space requirements are less than for an aerated lagoon - short detention times - can handle fairly moderate organic and hydraulic shock loads	- requires standby power in the event of outages - operator intensity somewhat higher than for an aerated lagoon - sludge handling required on a regular basis	$250,000	$2,000	700

encountered in the area, a synthetic liner would be required, which causes a significant capital cost. Based on these two factors, no further consideration of this system is given.

4. Aerated Lagoon

An aerated lagoon appears to be the most attractive method of wastewater treatment for Harvie Heights. The major advantages are as follows:

- minimal land area requirements
- can meet setback requirements as established by Alberta Environment
- will handle the hydraulic and organic shock loads readily which can be anticipated at Harvie Heights due to the large percentage of secondary residences, plus motels
- both the power and man-hours for operation are deemed reasonable
- continual discharge to the Bow River is available
- the capital cost for this system seems to be the most feasible to Harvie Heights

5. Mechanical Rotating Biological Contactor (RBC)

A package RBC plant could be utilized at Harvie Heights, however some minor drawbacks are as follows:

- labor intensity somewhat higher than that of an aerated lagoon
- will not handle shock (organic and hydraulic) loads as well as an aerated lagoon (would require equalization tankage)
- capital costs somewhat higher than the aerated lagoon

6. Regional System (Discharge to Canmore)

Though not included in the analyses of Table III, another option for wastewater treatment is discharging sewage to Canmore's existing sewage treatment plant. There are two basic routes available for the trunklines, and are described as follows:

a) Trunkline Route Located on South Side of the TransCanada Highway

A trunkline installed on the south side of the Trans-Canada Highway would cost approximately $550,000 to $650,000 (excluding easements). Due to a lack of contours and geotechnical information, an estimated range must be made at this time. Also, an unknown additional cost would be the assessment charge which would be levied by the Town of Canmore. In essence, this amount would cover oversize costs for use of such items as the Town's lift station, trunk-main, sewage treatment facility and outfall. A "guesstimate" would be $100,000 to $250,000. As it was not within the terms of the study to approach Canmore for these assessment costs, we would stress the limited accuracy.

b) Trunkline Route Located on North Side of the TransCanada Highway

The estimated capital costs to install this trunk are approximately $450,000 (excluding easements). The assessment costs of $100,000 to $250,000 as described above would also be applicable to this alternate.

D. FINANCIAL ANALYSES - OFFSITES

1. Cost Estimate - Aerated Lagoon

For those offsite components, the following estimated costs are envisaged for the aerated lagoon and its associated appurtenances:

Lift Station	$ 75,000
Force Main	44,000
Highway Crossing	80,000
Aerated Lagoon	163,000
Lagoon Site Piping	32,000
Outfall to Bow River	20,000
Sub-Total	$414,000

Sub-Total (brought forward)	$414,000
Contingency Sum @ 20% (includes engineer. legal survey, soils testing, etc.)	82,800
	$496,800
Land - 2 ac. @ $1000/ac. (est.)	2,000
Interim Financing, Admin. (est.)	15,000
	$513,800

2. Financial Assistance

a) Alberta Utilities and Telecommunications current grant program (Alberta Municipal Water Supply and Sewage Treatment Grant Program) would be available for a portion of the offsite costs (as of January 1985 research). The proportionate amounts are estimated as follows:

- assume population level 159 persons (permanent residents 1981 Federal census)
- upper grant limit (available to Harvie Heights) calculated as follows:
  600 -159 persons = 441
  441 x $5/cap. = $2205 + $2100 = $4305/cap.
  159 x $4305/cap. = $684,495.00
  75% by Alberta U & T = $513,371.25
  25% by Harvie Heights = $171,123.75

actual sewage treatment costs of $513,800 (which is less than upper limit)

therefore 75% by Alberta U & T = $385,350.00
25% by Harvie Heights = $128,450.00

b) Annual Debenture Cost

(assumed) n = 25 years; i = 13%; CRF = 0.1364

The annual payment for Harvie Heights is
$128,450 x CRF = $17,524.22/yr.

3. Frontage Assessments

An estimate of the frontages are as follows (front footages are calculated from the front of a lot at a distance of 1/3 the overall length)

Residential = 9664 front feet (FF)

Commercial = 3181 FF

See possible means of assessments on the following enclosed Table IV.

4. Annual Operating Costs

For the purposes of this study, we have assumed the following criteria:

Operator $2500/month (@ part-time rate)	=	$1250/mo.
Power Costs and Gas	=	200/mo.
Budget Cost for Replacement Parts	=	100/mo.
Vehicle and Disbursements	=	200/mo.
		$1750/mo.

Total Estimated Operating Cost is

$1750/month x 12 months = $21,000/year

See Table IV for inclusion of operating cost within the frontage assessment analyses.

TABLE IV — VARIOUS ESTIMATED METHODS OF ANNUAL DEBENTURE AND OPERATING COST RECOVERY FOR THE SEWAGE TREATMENT FACILITY AND ASSOCIATED OFFSITES

OPTION	LAND USE DESIGNATION	CONDITION OF ASSESSMENT	COMMENTS	* SERVICE CHARGE - ESTIMATED (TYPICAL) ANNUAL DEBENTURE RESIDENTIAL	COMMERCIAL	* ESTIMATED (TYPICAL) ANNUAL OPERATING CHARGE RESIDENTIAL	COMMERCIAL	* COMBINED ANNUAL SERVICE AND OPERATING CHARGE RESIDENTIAL	COMMERCIAL
A	Residential Highway Commercial	9,664 FF 3,181 FF 12,845 FF	Assuming that the frontage of residential and commercial is treated equally	$1.36/FF = $102.32	$1.36/FF = $272.00	$1.63/FF = $122.25	$1.63/FF = $326.00	$224.57	$ 598.00
B	Residential Highway Commercial	typical acreage typical acreage	Comparing the lots on an assumed acreage basis Total Residential = 120 x .25 ac = 30 ac Total Commercial = 29 ac Operating Costs for Residential 1/3 of Commercial (assumed)	$297.02/ac = $74.26	$297.02/ac = $653.44	$0.72/FF = $54.33	$4.40/FF = $880.23	$128.59	$1,533.67
C	Residential Highway Commercial	0 FF 3,181 FF	Assumes that the commercial properties recover the costs of the STP oversize, while the residential portion is paid for by Alta. T & U grant (capital cost only). Operating costs for Residential 1/3 of Commercial (assumed)	$ 0 FF = $ 0	$5.51/FF = $1,102.00	$0.72/FF = $54.33	$4.40/FF = $880.23	$ 54.33	$1,982.23

* Assumed Factors

- Residential Lot 75 foot frontage (.25 ac)
- Commercial Lot 200 foot frontage (2.2 ac)
- Annual Debenture Cost = $17,524.22/yr.
  n = 25 i = 13%

V. SUMMARY, RECOMMENDATIONS AND IMPLEMENTATION PROGRAM

1. Summary

a) The design population level of 500 persons for the next twenty to twenty-five years of growth at Harvie Heights concurs with projections of the CRPC and the Bow Corridor Regional Utilities Study.

b) A sanitary collection system can be installed for Harvie Heights at a fairly reasonable cost, while considering that pavement rehabilitation will be required.

c) If one of the two lower sewage collection cost alternatives is selected by I.D. 8 Council (a system consisting of some low pressure pump units unstalled where deep cuts would otherwise be required for a conventional gravity system), detailed design will delineate specifically which homes (or lots) will be affected.

d) An aerated lagoon will handle the wastewater treatment adequately for the hydraulic and organic shock loads anticipated in the Harvie Heights area. Also, this system seems to be the most feasible for Harvie Heights in both capital and operating costs.

e) The Bow Corridor Regional Utilities Study denotes that the two main options available to Harvie Heights for wastewater treatment are an aerated lagoon or discharge to Canmore.

2. Recommendations and Implementation Program

a) Any community with a population such as Harvie Heights (approximately 390 persons) should consider seriously the implementation of a wastewater collection system and treatment facility to prevent the possibility of contaminating the domestic local water supply source, which consists of independent water wells.

b) An application for grant monies should be made to Alberta Utilities and Telecommunications to ensure funding is in place for system implementation, if so required by Council.

c) Consideration and possible negotiations for land purchase of the sewage treatment facility site and roadway should proceed promptly.

d) The estimates as provided are based on current January 1985 prices, which are somewhat "recessionary". To take advantage of these low prices, construction should be considered in 1985.

e) As a minimum, some basic design should be implemented to determine the best trunkline route, highway crossing and railroad crossing, and application for the necessary easements and permits.

f) The piezometers installed for groundwater monitoring should be observed periodically.

g) If this project proceeds, I.D. 8 Council should consider a wastewater quality bylaw to ensure that oil and grease wastes are not discharged from the Highway Commercial area to the treatment facility.

APPENDIX "A"

Golder Associates
CONSULTING GEOTECHNICAL AND MINING ENGINEERS

GEOTECHNICAL INVESTIGATION FOR HARVIE HEIGHTS SEWAGE COLLECTION AND TREATMENT SYSTEM At Harvie Heights, Alberta

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Calgary, Alberta
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Calgary, Alberta

842-2089

December 1984

Golder Associates
CONSULTING GEOTECHNICAL AND MINING ENGINEERS

December 18, 1984 Ref. No.842-2089

Scott & Assoc. Engineering Ltd.
P.O. Box 4, Site 26,
R.R. 2
Calgary, Alberta
T2P 2G5

Attention: Mr. Bryan G. Scott, P. Eng.

RE: GEOTECHNICAL INVESTIGATION FOR HARVIE HEIGHTS
SEWAGE COLLECTION AND TREATMENT SYSTEM

Dear Sir:

We are pleased to submit herewith the results of a geotechnical investigation conducted for preliminary design of the Harvie Heights Sewage Collection and Treatment System. Terms of reference are given in our proposal letter dated June 27, 1984 and the acceptance letter dated November 29, 1984 from Scott & Assoc.

1.0 FIELD INVESTIGATION

Four test pits were excavated at the site of the proposed lagoons. The test pits were excavated using a Case 680 backhoe to depths ranging from 3.5 to 4.0 m below ground surface. The test pits which were excavated on December 5th were inspected in detail by our technician and the stratigraphy logged. The test pits were backfilled upon completion of excavation and the locations staked for future identification.

Five boreholes were put down on December 7th using a Becker percussion drill to depths of 5.2 to 7.9 m. The drilling operations were supervised by a geotechnical technician who also recorded the stratigraphy.

Samples were returned to our laboratory for detailed inspection and selected laboratory testing. It had been intended to drill a sixth borehole on the north side of the Trans Canada Highway; however, due to time limitations in the field and the similarity of stratigraphy at boreholes 4 and 5, the sixth borehole was deleted from the exploration program.

Standpipes were installed in each of the five boreholes for subsequent water level measurements. Logs for the boreholes and test pits and a site location plan showing their location are attached to the rear of this report. Samples remaining after testing will be stored in our laboratory until January 31, 1985 at which time they will be discarded unless we are instructed beforehand to the contrary.

2.0 SUBSURFACE CONDITIONS

Boreholes 1, 2 and 3 are located where the collection system is proposed within the community. All three of these borings encountered a dense to very dense gravel deposit at depths ranging from 2.1 to 4.9 m below the existing ground surface. The gravel is overlain by fine grain soils (silty clay and silty clay till some of which is fill) which offered much less resistance to drilling. All three boreholes were dry upon completion of drilling but standpipes were installed for subsequent water level measurements.

Borehole 4 was put down at the location of the proposed pumphouse. The stratigraphy at this location was determined to be fill overlying silt till which in turn, is underlain by a very dense gravel deposit at a depth of 3.7 m below ground surface. Free water was encountered towards the bottom of the borehole and a standpipe was installed for future water level measurements.

Borehole 5 is located near the crossing of the lagoon discharge line beneath the CPR tracks. The stratigraphy at this location was found to consist of clayey silt overlying gravel at a depth of 3.1 m. No free water was encountered during the drilling of this borehole but readings should be taken in the standpipe to confirm the depth to groundwater.

The four test pits excavated at the lagoon site gave a similar stratigraphy to that excavated at borehole 5, i.e. silt overlying gravel. The gradation of a typical sample of silt is shown on Figure 1 attached to this report. The silt was 2.0 m thick at Test Pit 3 at the eastern extremity of the site and increased in thickness to the west where at Test Pit 4 it was found to be greater than 4 m. All test pits were dry on completion of excavation.

3.0 DISCUSSION

3.1 Pipeline System

A sewage collection system will be constructed within the community and the sewage discharged in a pipeline situated along the north side of the Trans Canada Highway and east of the community and then will cross beneath the Trans Canada Highway to a lagoon system. Effluent from the lagoons will be discharged in a pipeline crossing beneath the CPR railroad and emptying into the Bow River.

Within the Harvie Heights community, the borings and topographical features indicate that the pipeline excavation should not encounter bedrock nor groundwater, although depending upon the season of the year and climatic conditions, perched groundwater could perhaps be encountered. Where the pipeline is located within the bottom of the Bow River Valley, groundwater can be expected to encountered in the gravel. The depth to the groundwater table will be at a minimum in June and July due to the

snowmelt runoff. Wherever possible, excavation below the groundwater table should be avoided as the gravel is pervious and a considerable inflow of water can be expected. However, experience in the Canmore and Banff areas indicates that the groundwater can be controlled by pumping from large capacity pumps.

Pipeline crossings beneath the Trans Canada Highway and railroad are planned to be bored or jacked beneath these facilities to avoid disruption of traffic. If possible, it would be advantageous to bore or jack the pipeline through the fine grain soils overlying the gravel deposit.

A pumping station may be required in the vicinity of Borehole 4. Depending upon the depth of excavation, groundwater may be encountered as discussed previously for the pipeline and the base of the pumping station may be found in either the till of the underlying gravel. Footings or mat foundations may be designed for an allowable bearing pressure of 200 kPa in either the till or gravel. Precautions should be taken to prevent the possibility of flotation of the pump station during high groundwater conditions.

3.2 Sewage Lagoons

Two lagoons are proposed, each being approximately 40 m by 60 m in plan with side slopes of 3 horizontal:1 vertical, 3 m depth of liquid and 0.6 m of freeboard. It is recommended that the elevation on the bottom of the lagoons be selected so that they are above the seasonal groundwater table. This is important for two reasons. Firstly, it avoids construction difficulties during excavation but also prevents the possibility of flotation of the impervious membrane which could happen if the lagoon were to be dewatered when the groundwater table is above the bottom of the liner. At this location the water table will be closely controlled by the level of the adjacent Bow River and hence records of the in the river elevation should be studied.

Neither the silt nor the gravel are sufficiently impervious to be used as a liner. It has also been our experience in this area that impervious clay is not available in sufficient quantity to be used as a liner. Therefore, it will be necessary to line the lagoon with an artificial liner.

3.2.1 PVC Liner

A polyvinylchloride (PVC) liner is a practical consideration for this site. It must be resistant to sewage (most PVC liners satisfy this requirement) and must be of at least 20 mil thickness to prevent puncture during placement of the liner and overlying cover material. The liner must be covered with at least 150 mm of soil to prevent breakdown of the material upon exposure to sunlight; the cover also acts as a deterrent to vandals although lagoons are commonly fenced and locked.

The silt at the site may be used as both a bedding and a cover material. Although inspection of the test pits indicated that the silt is relatively free of gravel size material, it will be essential to remove such material from both the bedding and the cover to prevent possible puncture of the liner. Spreading of the cover must be done very carefully so that the equipment tires or tracks do not cause puncture of the liner. The spreading operation must be done with light equipment such as Bobcats. Reference should be made to the manufacturer of the liner for specifications regarding anchoring of the liner at the crest of the dyke and also for sealing of the sheets of material and allowance for slack. To prevent erosion of the cover material due to wave action, it is recommended that a layer of coarse gravel with sizes of 150 to 250 mm be used and it should extend approximately 0.6 m vertically below the water level. The gravel underlying the silt at this site may be suitable for this purpose provided it is obtained selectively. If the pond level is to be lowered on a regular basis for cleaning purposes, the gravel layer should extend over the entire lagoon sides and bottom. The gravel would

not only protect against possible erosion during the dewatering process but would also minimize the possibility of damage due to equipment traversing the liner. Inspection should be made from time to time during the life of the facility to ensure that the liner does not become exposed.

3.2.2 Asphaltic Liner

An asphaltic liner has recently come onto the market which may possibly be an alternative to the more conventional PVC liner. The asphaltic liner consists of two layers of bitumen bonded to a reinforcing fabric; slate granules are bonded to the outside surface. Base preparation requirements are not as stringent as for PVC and a soil cover is not required to prevent deterioration. The material has been used with apparent success for lining irrigation canals in the Strathmore area and it is understood that its use is planned for several other canal applications. The supplier (Aquiliners Canada Ltd.) claims it can be used for sewage lagoons.

3.3 Earthworks

Both the silt and the gravel are suitable for re-use as fill in the dykes. The test pit excavations indicate that the silt and the gravel where it is above the water table are dry of optimum and the addition of water will be necessary to achieve the required compaction. Topsoil should be stripped from beneath the lagoon and stockpiled for subsequent re-use on the outside slopes of the dykes or elsewhere. All fill should be compacted to a minimum of 95 percent standard Proctor dry density; the soil exposed beneath the dykes and lagoon bottom after stripping and excavation should be similarly compacted. Boulders may be encountered particularly within the gravel and should not be incorporated in the fill but instead should be disposed along the outside slope of the dyke or elsewhere.

3.4 Foundations

A small unheated structure housing equipment for aeration purposes is commonly constructed near the lagoons. If such a structure is prepared for this project, it is recommended that the foundations be founded on the gravel rather than the silt which is considered unsuitable for this purpose. Alternatively, the footings may be carried on engineered fill overlying the gravel provided that the fill is compacted to at least 95 percent standard Proctor dry density. The footings should be buried to a depth of at least 2 m below grade for frost protection purposes. Alternatively, styrofoam insulation may be used to minimize frost protection requirements.

4.0 CLOSURE

When this project advances to final design, additional geotechnical investigation may be warranted. Additional borings may be considered within the Harvie Heights community to confirm subsurface conditions. As well, it may be prudent to provide additional subsurface information along the pipeline route, particularly at the Trans Canada Highway crossing.

Respectfully submitted
GOLDER ASSOCIATES

W.J. Burwash, P. Eng.

WJB:kk

Dec 18/84

LIST OF ABBREVIATIONS

The abbreviations commonly employed on each "Record of Borehole," on the figures and in the text of the report, are as follows:

I. SAMPLE TYPES

AS	auger sample
CS	chunk sample
DO	drive open
DS	Denison type sample
FS	foil sample
RC	rock core
ST	slotted tube
TO	thin-walled, open
TP	thin-walled, piston
WS	wash sample

II. PENETRATION RESISTANCES

Dynamic Penetration Resistance: The number of blows by a 140-pound hammer dropped 30 inches required to drive a 2-inch diameter, 60 degree cone one foot, where the cone is attached to 'A' size drill rods and casing is not used.

Standard Penetration Resistance, *N*: The number of blows by a 140-pound hammer dropped 30 inches required to drive a 2-inch drive open sampler one foot.

WH sampler advanced by static weight—weight, hammer

PH sampler advanced by pressure—pressure, hydraulic

PM sampler advanced by pressure—pressure, manual

III. SOIL DESCRIPTION

(a) *Cohesionless Soils*

Relative Density	*N, blows/ft.*
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) *Cohesive Soils*

Consistency	c_u, *lb./sq. ft.*
Very soft	Less than 250
Soft	250 to 500
Firm	500 to 1,000
Stiff	1,000 to 2,000
Very stiff	2,000 to 4,000
Hard	over 4,000

IV. SOIL TESTS

C	consolidation test
H	hydrometer analysis
M	sieve analysis
MH	combined analysis, sieve and hydrometer[1]
Q	undrained triaxial[2]
R	consolidated undrained triaxial[2]
S	drained triaxial
U	unconfined compression
V	field vane test

NOTES:

[1]Combined analyses when 5 to 95 per cent of the material passes the No. 200 sieve.

[2]Undrained triaxial tests in which pore pressures are measured are shown as $\bar{Q}$ or $\bar{R}$.

LIST OF SYMBOLS

I. GENERAL

$\pi = 3.1416$

e = base of natural logarithms 2.7183

$\log_e a$ or $\ln a$, natural logarithm of a

$\log_{10} a$ or $\log a$, logarithm of a to base 10

t	time
g	acceleration due to gravity
V	volume
W	weight
M	moment
F	factor of safety

II. STRESS AND STRAIN

u	pore pressure
σ	normal stress
σ'	normal effective stress ($\bar{\sigma}$ is also used)
τ	shear stress
ϵ	linear strain
ϵ_{xy}	shear strain
ν	Poisson's ratio (μ is also used)
E	modulus of linear deformation (Young's modulus)
G	modulus of shear deformation
K	modulus of compressibility
η	coefficient of viscosity

III. SOIL PROPERTIES

(a) *Unit weight*

γ	unit weight of soil (bulk density)
γ_s	unit weight of solid particles
γ_w	unit weight of water
γ_d	unit dry weight of soil (dry density)
γ'	unit weight of submerged soil
G_s	specific gravity of solid particles $G_s = \gamma_s/\gamma_w$
e	void ratio
n	porosity
w	water content
S_r	degree of saturation

(b) *Consistency*

w_L	liquid limit
w_P	plastic limit
I_P	plasticity index
w_S	shrinkage limit
I_L	liquidity index $= (w - w_P)/I_P$
I_C	consistency index $= (w_L - w)/I_P$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
D_r	relative density $= (e_{max} - e)/(e_{max} - e_{min})$

(c) *Permeability*

h	hydraulic head or potential
q	rate of discharge
v	velocity of flow
i	hydraulic gradient
k	coefficient of permeability
j	seepage force per unit volume

(d) *Consolidation (one-dimensional)*

m_v	coefficient of volume change $= -\Delta e/(1+e)\Delta\sigma'$
C_c	compression index $= -\Delta e/\Delta \log_{10} \sigma'$
c_v	coefficient of consolidation
T_v	time factor $= c_v t/d^2$ (d, drainage path)
U	degree of consolidation

(e) *Shear strength*

τ_f	shear strength	
c'	effective cohesion intercept	in terms of effective stress $\tau_f = c' + \sigma' \tan \phi'$
ϕ'	effective angle of shearing resistance, or friction	
c_u	apparent cohesion*	in terms of total stress $\tau_f = c_u + \sigma \tan \phi_u$
ϕ_u	apparent angle of shearing resistance, or friction	
μ	coefficient of friction	
S_t	sensitivity	

*For the case of a saturated cohesive soil, $\phi_u = 0$ and the undrained shear strength $\tau_f = c_u$ is taken as half the undrained compressive strength.

RECORD OF TEST PIT T.P. 1

Location (See Figure 2)

Date 5 Dec '84

Datum

Method of Excavation Case 680H Extend A Hoe

Project

ELEV. / DEPTH (m)	DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	ADDITIONAL LAB. TESTING	WATER CONTENT - % (W_p W W_L)	GROUNDWATER CONDITIONS / REMARKS
	Ground surface					
0.00	TOPSOIL					
0.15	Brown SILT, dry to moist, trace clay, low plastic		1 (CS) 2 (CS) 3 (CS) 4 (CS)			
2.30	GRAVEL, well graded, silty, sandy, moist					Test Pit dry after excavation
3.50	Bottom of Test Pit					

Vertical Scale 1:50

Sheet 1 of 1

RECORD OF TEST PIT T.P. 2

Location (See Figure 2)

Date 5 Dec '84

Datum

Method of Excavation Case 680H Extend A Hoe

Project

ELEV. / DEPTH (m)	DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	ADDITIONAL LAB. TESTING	WATER CONTENT - % (W_P W W_L)	GROUNDWATER CONDITIONS / REMARKS
	Ground surface					
0.00	TOPSOIL					
0.15	SILT, dry to moist, low plastic, brown		1 (cs)			
			2 (cs)			
			3 (cs)			
4.00	Bottom of Test Pit		4 (cs)			Test Pit dry after excavation

Vertical Scale 1:50

Sheet 1 of 1

RECORD OF TEST PIT T.P. 3

Location (See Figure 2) | Date 5 Dec '84

Datum

Method of Excavation Case 680H Extend A Hoe | Project

ELEV. / DEPTH (m)	DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	ADDITIONAL LAB. TESTING	WATER CONTENT - % (W_p W W_L)	GROUNDWATER CONDITIONS REMARKS
	Ground surface					
0.00	TOPSOIL					
0.15	Brown SILT, dry to moist, low plastic		1 (CS) 2 (CS) 3 (CS)			
2.00	GRAVEL, well graded, silty, dry to moist					Test Pit dry after excavation
3.50	Bottom of Test Pit					

Vertical Scale 1:50

Sheet 1 of 1

PROJECT NO 842-2089 DRAWN RK REVIEWED B DATE DEC '84

RECORD OF TEST PIT T.P. 4

Location (See Figure 2)

Date 5 Dec '84

Datum

Method of Excavation Case 680H Extend-A-Hoe

Project

ELEV. / DEPTH (m)	DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	ADDITIONAL LAB. TESTING	WATER CONTENT - % W_P W W_L	GROUNDWATER CONDITIONS REMARKS
	Ground surface					
0.00	TOPSOIL					
0.15	Brown SILT, dry to moist, low plastic		1 (cs) 2 (cs) 3 (cs)			
4.00	Bottom of Test Pit		4 (cs)			Test Pit dry after excavation

Vertical Scale 1:50

Sheet 1 of 1

PROJECT NO. 842-2089 DRAWN RK REVIEWED ? DATE DEC 84

RECORD OF BOREHOLE BH. 1

LOCATION (See Figure. 2.)
BORING DATE 7 Dec '84
BOREHOLE TYPE Becker
BOREHOLE DIAMETER
SAMPLE HAMMER WEIGHT
DROP
DATUM

ELEV. DEPTH. (m)	DESCRIPTION (SOIL PROFILE)	STRATIGRAPHY PLOT	SAMPLE NUMBER	SAMPLE TYPE	BLOWS / 300 mm	ELEVATION SCALE	WATER CONTENT PERCENT W_P — W — W_L	PIEZOMETER OR STANDPIPE INSTALLATION / ADDITIONAL LAB. TESTING
	Ground surface							
0.00	TOPSOIL, peat, wood fibres				54			
0.30	Silty CLAY TILL				192			
					170			
					123			Cuttings backfill
					156			
					315			Slotted standpipe
			1	C.S.	230			
2.13	GRAVEL, very dense, well graded, sandy				240			
					395			
					544			
			2	C.S.	240			
					275			
					525			
					256			
					293			
					331			
			3	C.S.	334			
5.18	End of Borehole							

Project No 842-2089 Drawn RK Reviewed [illegible] Date DEC '84

VERTICAL SCALE 1:50

Golder Associates

BORE HOLE No. BH. 1

RECORD OF BOREHOLE BH. 2

LOCATION (See Figure. 2.)
BOREHOLE TYPE Becker
SAMPLE HAMMER WEIGHT
DROP
BORING DATE 7 Dec '84
BOREHOLE DIAMETER
DATUM

ELEV. DEPTH. (m)	SOIL PROFILE DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	SAMPLE TYPE	BLOWS / 300 mm	ELEVATION SCALE	WATER CONTENT PERCENT W_p W W_l	PIEZOMETER OR STANDPIPE INSTALLATION ADDITIONAL LAB. TESTING
	Ground surface							
0.00	ASPHALT				556			
0.15	CLAY TILL (Probably FILL)				150			
					25			
					15			
1.22	silty CLAY, soft to firm		1	C.S.	0			
					0			cuttings backfill
					0			
					0			
			2	50mm DO.	0			(N=2)
					0			
3.05	GRAVEL, dry, dense, sandy				10			
					24			slotted standpipe
					14			
					11			
					17			
					45			
					73			
					56			
5.49	End of Borehole							

Project No 842-2089 Drawn RK Reviewed [signature] Date DEC '84

VERTICAL SCALE 1:50

Golder Associates

BORE HOLE No. BH 2

RECORD OF BOREHOLE BH. 3

LOCATION (See Figure. 2.) BORING DATE 7 Dec. '84
BOREHOLE TYPE Becker BOREHOLE DIAMETER
SAMPLE HAMMER WEIGHT DROP DATUM

ELEV. DEPTH. (m)	SOIL PROFILE DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	SAMPLE TYPE	BLOWS / 300mm	ELEVATION SCALE	WATER CONTENT PERCENT W_p W W_l	PIEZOMETER OR STANDPIPE INSTALLATION ADDITIONAL LAB. TESTING
	Ground surface							
0.00	ASPHALT							
0.15	Silty CLAY, mottled with organics, wet, decomposed wood fibres, med. plastic		1	C.S.	467			
					41			
0.61					10			
					0			
					0			
					0			Cuttings backfill
	Silty CLAY, med. plastic, brown, firm, moist		2	C.S.	0			
					0			
			3	50mm D.O.	0			(N = 5)
					0			
					0			
					0			Slotted standpipe
	wetter, some gravel				4			
					10			
					11			
					10			
4.88					18			
					75			
					45			
					42			
	GRAVEL, well graded, dry, sandy, dense				37			
					30			
					20			
					30			
					99			
					129			
7.92	End of Borehole							

VERTICAL SCALE 1:50

Golder Associates

BORE HOLE No. BH 3
SHEET 1 OF 1

Project No 842-2089 Drawn RK Reviewed [illegible] Date DEC '84

RECORD OF BOREHOLE BH. 4

LOCATION (See Figure. 2)
BORING DATE 7 Dec '84
BOREHOLE TYPE Becker
BOREHOLE DIAMETER
SAMPLE HAMMER WEIGHT
DROP
DATUM

SOIL PROFILE

ELEV. DEPTH. (m)	DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	SAMPLE TYPE	BLOWS / 300 mm	ELEVATION SCALE	WATER CONTENT PERCENT W_p — W — W_l	PIEZOMETER OR STANDPIPE INSTALLATION / ADDITIONAL LAB. TESTING
	Ground surface							
0.00	FILL, Gravel, dense, frozen				328			
					724			
0.76	Silty CLAY TILL, possibly FILL				200			
					66			
					27			
1.52	Sandy SILT TILL, moist – gravelly below 2.6m		1	C.S.	14			cuttings backfill
			2	C.S.	10			
					22			
					46			
					49			slotted standpipe
					80			
					40			
3.66	GRAVEL, sandy, dense to very dense, moist to wet				82			
					110			
					155			
					206			
					126			
					177			
					232			
					223			
					275			
6.40	End of Borehole							

Project No 842-2089 Drawn RK Reviewed [illegible] Date DEC '84

VERTICAL SCALE 1:50

Golder Associates

BORE HOLE No. BH 4
SHEET 1 OF 1

RECORD OF BOREHOLE BH. 5

LOCATION (See Figure. 2.)
BORING DATE 7 Dec '84
BOREHOLE TYPE Becker
BOREHOLE DIAMETER
SAMPLE HAMMER WEIGHT
DROP
DATUM

ELEV. DEPTH. (m)	SOIL PROFILE DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	SAMPLE TYPE	BLOWS / 300 mm	ELEVATION SCALE	WATER CONTENT PERCENT W_p W W_L	PIEZOMETER OR STANDPIPE INSTALLATION / ADDITIONAL LAB. TESTING
	Ground surface							
0.00	TOPSOIL, decayed leaves, frozen				66			
0.15	Clayey SILT, medium to low plasticity, brown, moist to wet				14			
					9			
					2			
					0			Cuttings backfill
					0			
					0			
					0			
			1	C.S.	0			Slotted standpipe
					0			
3.05	GRAVEL, sandy, dry, dense				55			
					137			
					75			
					64			
					57			
					47			
					68			
			2	C.S.	65			
5.49	End of Borehole							

Project No 842-2089 Drawn RK Reviewed [signature] Date DEC '84

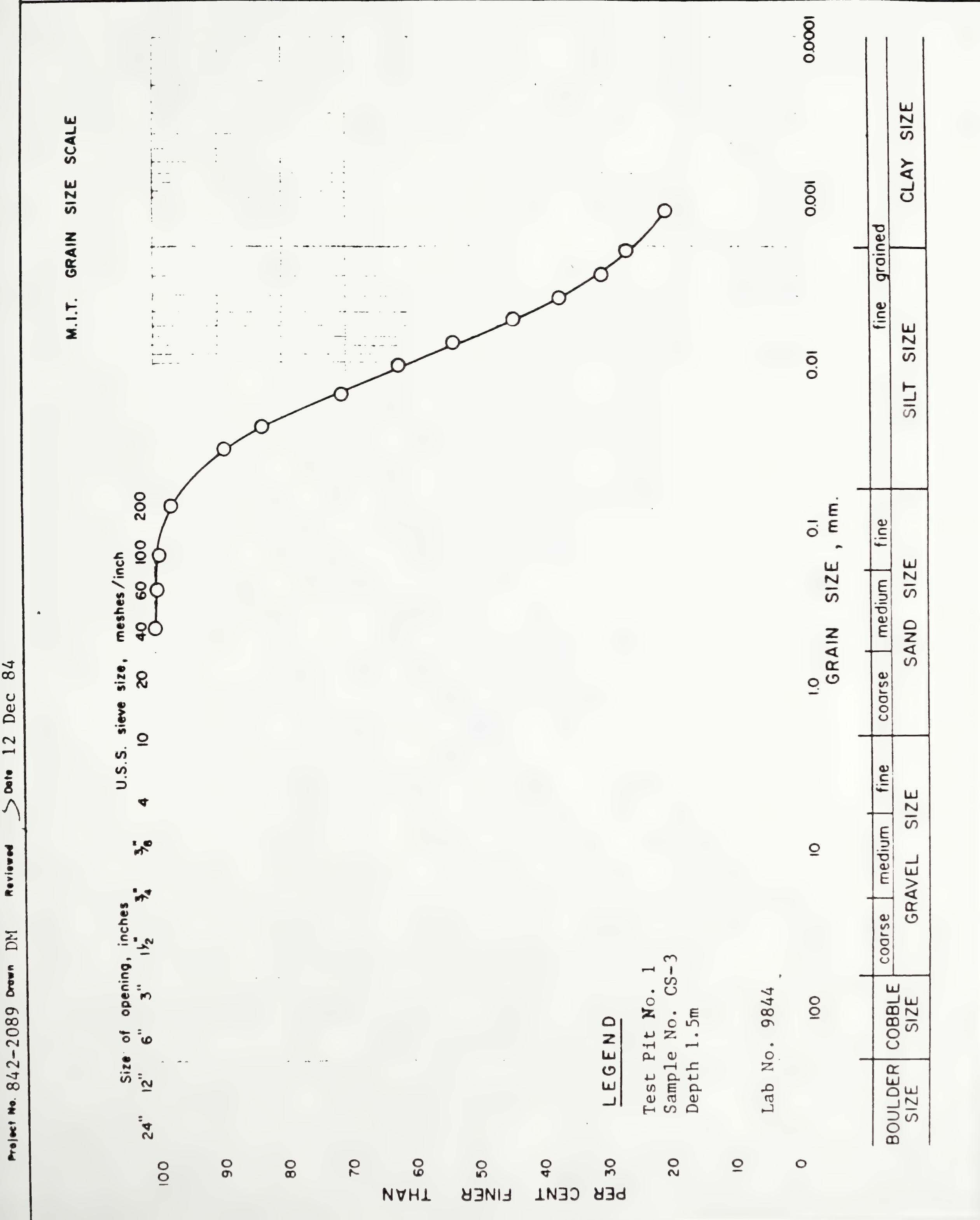
VERTICAL SCALE 1:50

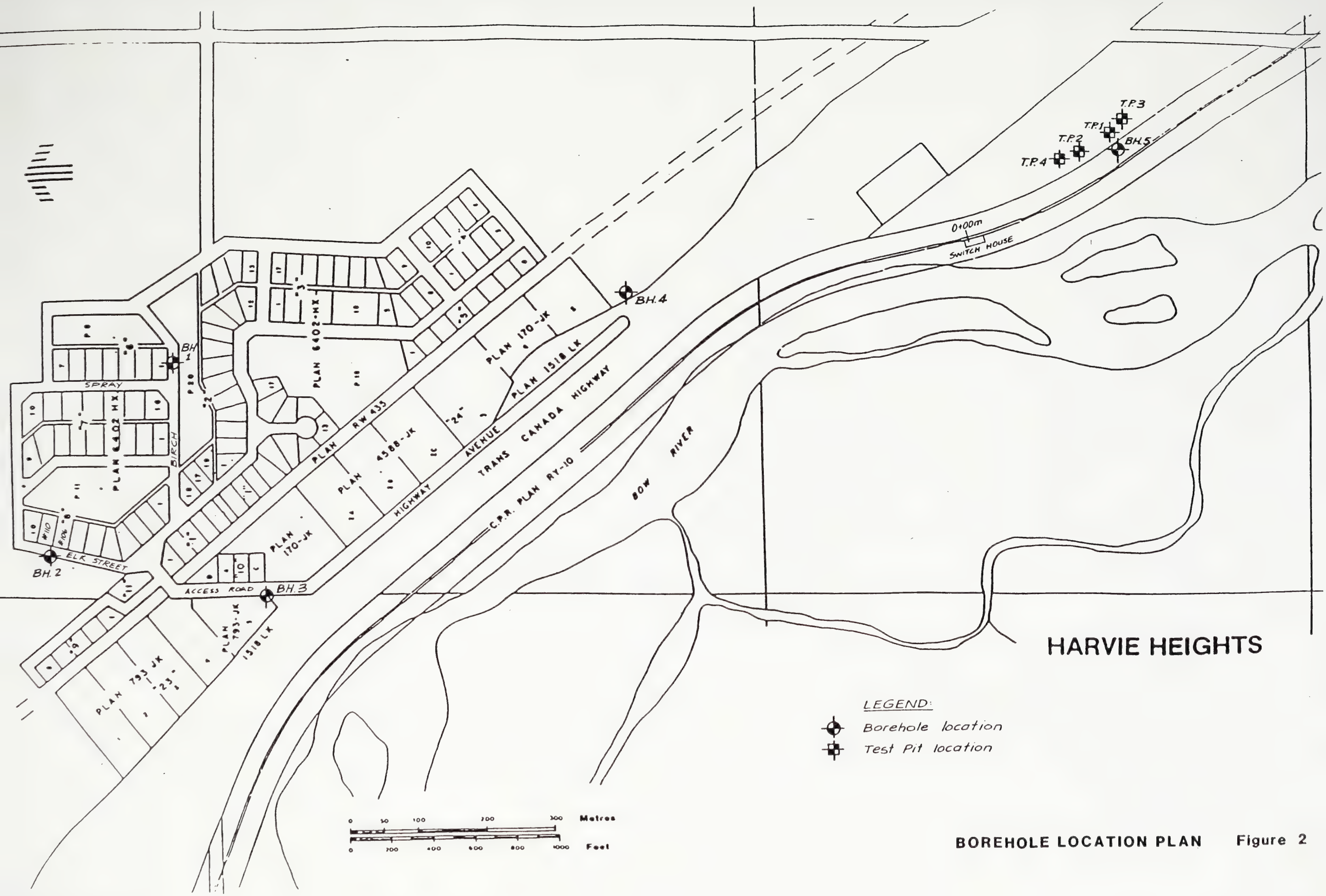
Golder Associates

BORE HOLE No. BH 5

GRAIN SIZE DISTRIBUTION

Figure 1





BOREHOLE LOCATION PLAN Figure 2

APPENDIX "B"

HYDROCON
326 - 510 - 5 Street S.W.
Calgary, Alberta
Canada, T2P 3S2
(403) 266-1135

December 14, 1984

File: 199-88.1

Mr. B. G. Scott, P.Eng.
Scott & Assoc. Engineering Ltd.
Box 4, Site 26, R.R. 2,
Calgary, Alberta
T2P 2G5

Dear Mr. Scott:

RE: **HARVIE HEIGHTS SEWAGE TREATMENT FACILITY ON BOW RIVER**

1.0 INTRODUCTION

Further to your letter of Nov. 28, 1984 and our recent discussions we are pleased to supply herein hydrologic/hydraulic input to your preliminary investigations relative to the above-noted facility.

1.1 SCOPE

Hydrocon's scope of work involved the preliminary investigation of the following:

1) Site suitability with respect to potential flooding from the Bow River and bank stability,

2) Comments on the type of river outfall that may be required.

3) Any other relevant hydrologic/river engineering comments for this preliminary investigation.

A brief site inspection was conducted by Gary Beckstead, P. Eng. on Dec. 1, 1984. Contour mapping was supplied by Scott & Associates.

Each of the above areas is discussed below.

1.2 LOCATION

The site of the proposed sewage treatment plant is SE 7-25-10-W5M, south of Harvie Heights (Drawing 1). The proposed sewage outfall would be located adjacent to the treatment plant, along the left (east) bank of the Bow River (Drawing 2).

2.0 SITE SUITABILITY

2.1 FLOODING

A rating curve has been developed for the Bow River at the inlet structure to Policeman Creek (Drawing 3), by Hydrocon based on stage measurements by Alberta Environment (AE) at their gauge #17. The elevation of the 1:100 year flood (484 m^3/s) at the rating curve site is 1314.9 mm (Drawing 3). Extrapolating this level 1500 m upstream to the study area at a slope of 0.0021, results in a 1:100 year flood level of 1317.9 m. Contour mapping indicates that the top of bank within the study area is at elevation 1320 m, approximately 2 m above the estimated 1:100 year flood level.

Drawing 2, based on an airphoto from the June 1974 flood (377 m^3/s, 1:15 year return period) indicates the site was not flooded during that event.

2.2 BANK STABILITY

The historical behaviour of the Bow River at the study area has been assessed using a township map from 1906, and air photos from Sept. 9 1959, Oct. 17, 1974 and Oct. 16, 1980. In general it appears that where the river is a single channel (as opposed to multi-channel separated by bars or islands) the river has been relatively stable. Specific areas along the left (east) bank at the study area (see Drawings 1 and 2) are discussed separately below:

- upstream of (a point) 500' (150 m) upstream of creek mouth, the river is multi-channeled, and exhibits instabilities.

- 300-500' (100-150 m) upstream of the creek mouth, the river is stable, and is not subject to a great deal of erosion due to the flow alignment from upstream. This would be a suitable site for a sewage outfall, but the line from the plant to the outfall would have to cross the creek enroute to the outfall.

- from 300' (150 m) upstream to 400' (120 m) downstream, significant bank erosion is occurring. The channel is adequate for an outfall site here (being deep and single-channel), but extensive erosion protection would be required.

- from 400' to 800' (120 - 245 m) downstream (adjacent to treed area along left bank) there is a minor gravel bar buildup, so erosion should not be as extreme as further upstream. At downstream end of this zone, the side channel has recently (since 1974) been closed off due to gravel deposition.

- from 800 - 2000' (245 - 610 m) downstream the channel is split, subject to shifting, and not suitable for an outfall site.

- beyond 2000' (610 m) downstream is the Canmore Golf Course - not suitable for a sewage outfall due to aesthetic reasons.

Thus the preferred site for the outfall would be approximately 120 m downstream of the creek outlet (Photo 1). Other possible although less preferrable sites would be from 120 to 245 m downstream or 100-150 m upstream of the creek outlet.

PHOTO 1

Preferred outfall site, 120 m downstream of creek outlet
HYDROCON PHOTO 199-1-9A Dec. 1, 1984

3.0 OUTFALL TYPE

As conditions at the study area, are similar to the site of the Town of Canmore's sewage outfall, it would be reasonable to use a similar type of outfall for the Harvie Heights facility. The Canmore outfall is illustrated in Photo 2.

PHOTO 2
Town of Canmore Sewage Outfall on Bow River
HYDROCON PHOTO 199-1-3A Dec. 1, 1984

The outfall should be located so that flow along the bank is not obstructed to a significant degree. The disturbed bank should be backfilled with gravel and armoured with heavy rock riprap (likely from the Exshaw quarries).

Allowances should be made for energy dissipation of the sewage outflow down the slope of the bank for low water levels.

The outfall should be placed at a level which would prevent frequent backup due to high river levels. A suitable design elevation may be prescribed when the location is finalized and the flood level determined.

4.0 CLOSURE

A properly designed outfall structure can be located on the Bow River in the vicinity of the treatment plant.

We trust that this brief evaluation is sufficient for your preliminary investigations at this time. Detailed hydrologic/hydraulic design input is required prior to commencement of construction.

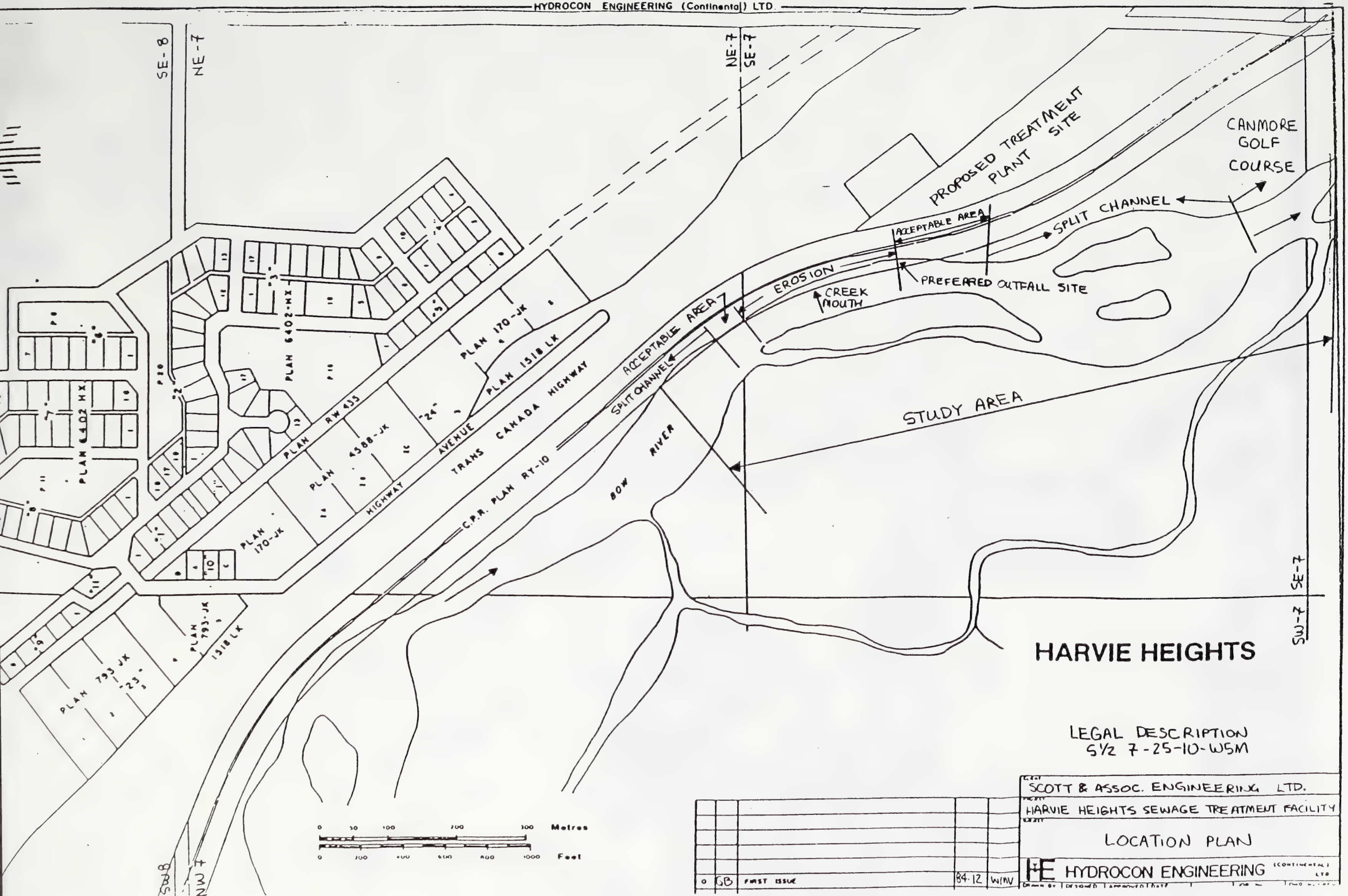
Yours truly,

HYDROCON ENGINEERING (Continental) LTD.

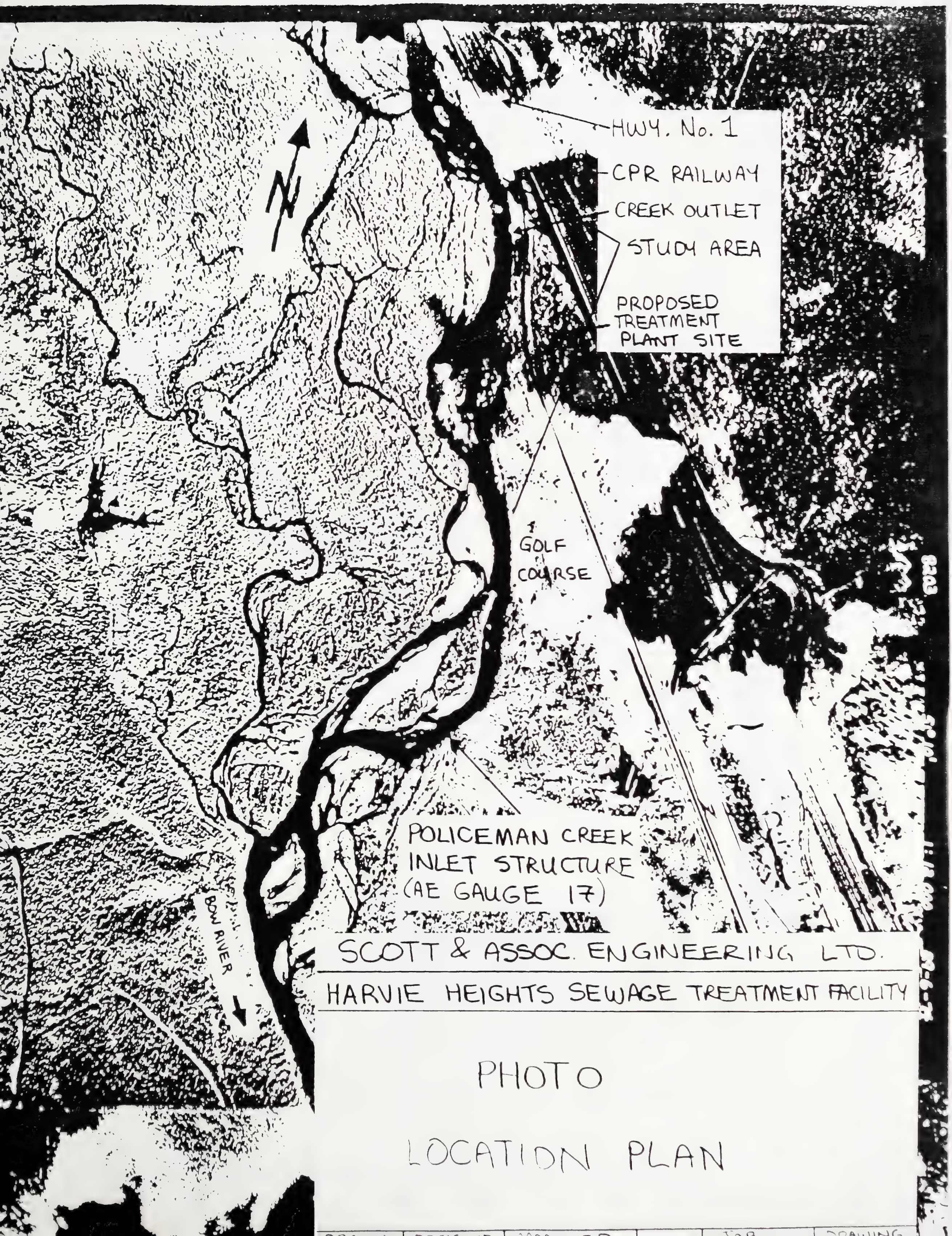
G. Beckstead
G. R. E. Beckstead, P. Eng.
Project Engineer

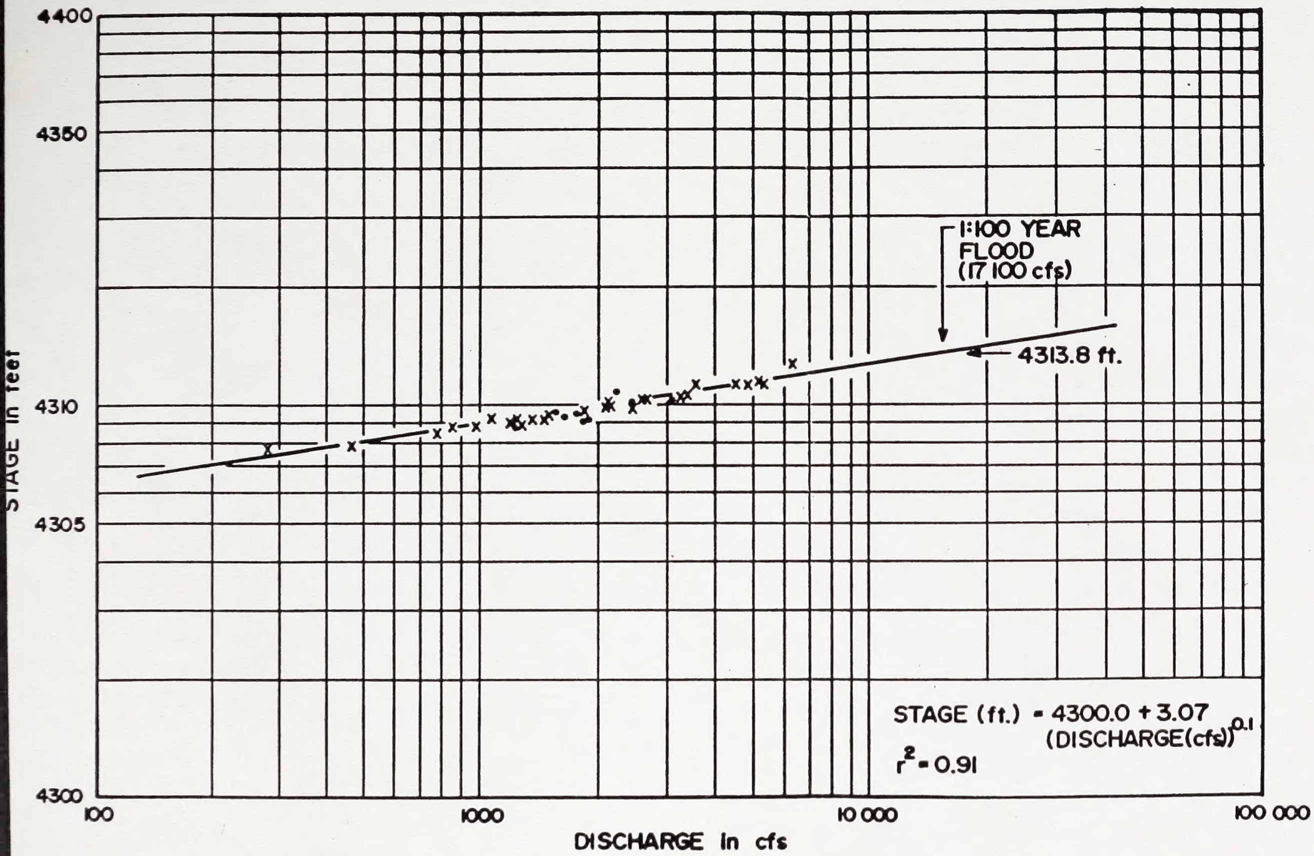
W. M. Veldman
W. M. Veldman, P.Eng.
President

GREB:aw



HYDROCON ENGINEERING (Continental) LTD.
SE-8
NE-7
NE-7
SE-7
PROPOSED TREATMENT PLANT SITE
CANMORE GOLF COURSE
SPLIT CHANNEL
ACCEPTABLE AREA
SPLIT CHANNEL
PREFERRED OUTFALL SITE
EROSION
CREEK MOUTH
ACCEPTABLE AREA
SPLIT CHANNEL
STUDY AREA
BOW RIVER
C.P.R. PLAN RY-10
TRANS CANADA HIGHWAY
HIGHWAY AVENUE
PLAN 1318 LK
PLAN 170-JK
PLAN RW 433
PLAN 4388-JK
PLAN 6402-HX
PLAN 793-JK
1318 LK
SE-7
SW-7
HARVIE HEIGHTS
LEGAL DESCRIPTION
S½ 7-25-10-W5M
Metres
Feet
SCOTT & ASSOC. ENGINEERING LTD.
HARVIE HEIGHTS SEWAGE TREATMENT FACILITY
LOCATION PLAN
HYDROCON ENGINEERING (CONTINENTAL) LTD
0 GB FIRST ISSUE 84.12 WMV


HWY. No. 1
CPR RAILWAY
CREEK OUTLET
STUDY AREA
PROPOSED TREATMENT PLANT SITE
N
GOLF COURSE
POLICEMAN CREEK INLET STRUCTURE (AE GAUGE 17)
BOW RIVER
SCOTT & ASSOC. ENGINEERING LTD.
HARVIE HEIGHTS SEWAGE TREATMENT FACILITY
PHOTO
LOCATION PLAN



STAGE - DISCHARGE CURVE
BOW RIVER AT GAUGE 17

REV	BY	DESCRIPTION	DATE	APPR'D
0	GB	FIRST ISSUE	84.12	WMV

CLIENT: SCOTT & ASSOC. ENGINEERING LTD.
PROJECT: HARVIE HEIGHTS SEWAGE TREATMENT FACILITY
SUBJECT: BOW RIVER RATING CURVE

HE HYDROCON ENGINEERING (CONTINENTAL) LTD

DRAWN BY	DESIGNED	APPROVED	DATE	JOB No	DWG No	REV
GB	GB	WMV	84.12	199	3	0

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